

EP 21819 (3)

(12) **UK Patent Application** (19) **GB** (11) **2 333 424** (13) **A**

(43) Date of A Publication 21.07.1999

(21) Application No 9901226.2

(22) Date of Filing 20.01.1999

(30) Priority Data

(31) 10008784 (32) 20.01.1998 (33) JP

(71) Applicant(s)

**NEC Corporation**  
(Incorporated in Japan)  
7-1 Shiba 5-chome, Minato-ku, Tokyo 108-01, Japan

(72) Inventor(s)

**Touru Tanaka**

(74) Agent and/or Address for Service

**Mathys & Squire**  
100 Grays Inn Road, LONDON, WC1X 8AL,  
United Kingdom

(51) INT CL<sup>6</sup>

**H04Q 7/38**

(52) UK CL (Edition Q)

**H4L LDSHX LECTP L1H10**

(56) Documents Cited

**GB 2328582 A**

(58) Field of Search

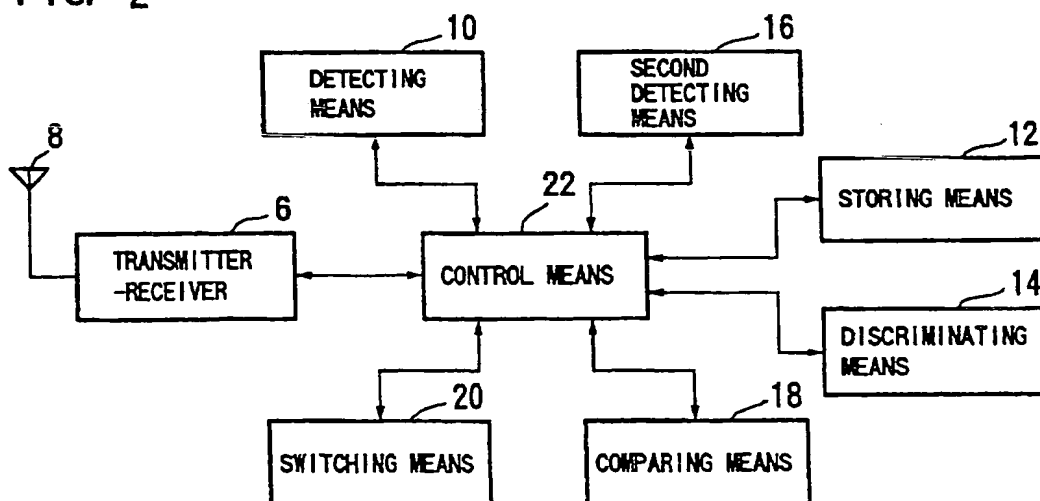
**UK CL (Edition Q) H4L LDSHE LDSHS LDSHX LECTP**  
**INT CL<sup>6</sup> H04Q 7/18 7/38**  
**ONLINE: WPI, EDOC, PAJ**

(54) Abstract Title

**Mobile phone unit**

(57) The invention relates to a phone unit in which power consumption required to change connection between base stations is reduced. A control section (figure 2) compares the signal strength of a local station with a threshold value and, when it is not lower, continues communication. When the signal strength of the local station is determined to be lower than the threshold, a detecting section (16) detects the signal strengths of other base stations and comparison means (18) selects the one with the highest strength. Moreover, the comparison means compares the signal strength of the selected base station with that of the local station and, when it exceeds that of the local station, switches connection from the local station to the selected station. Consequently, when the phone unit exists in a zone of adequate power, no base station detecting operation is executed and the power associated with the detecting operation is conserved.

**FIG. 2**



**GB 2 333 424 A**

FIG. 1

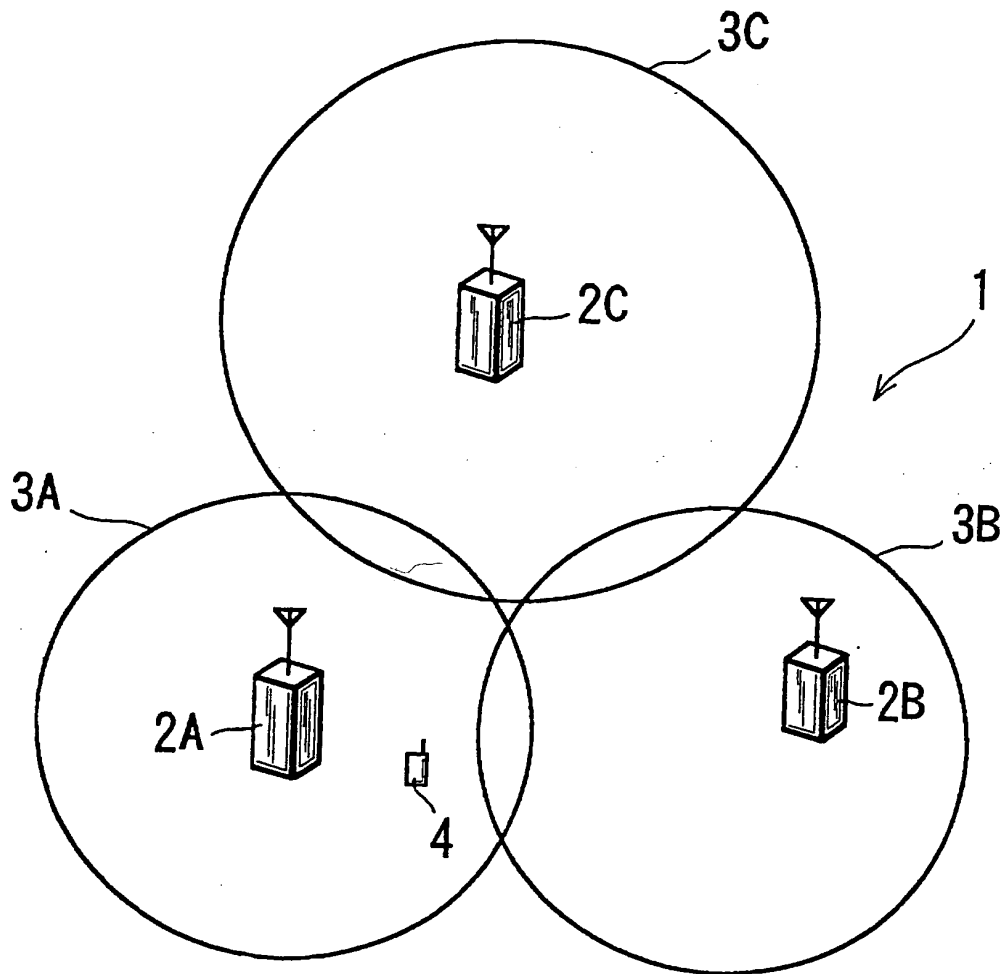


FIG. 2

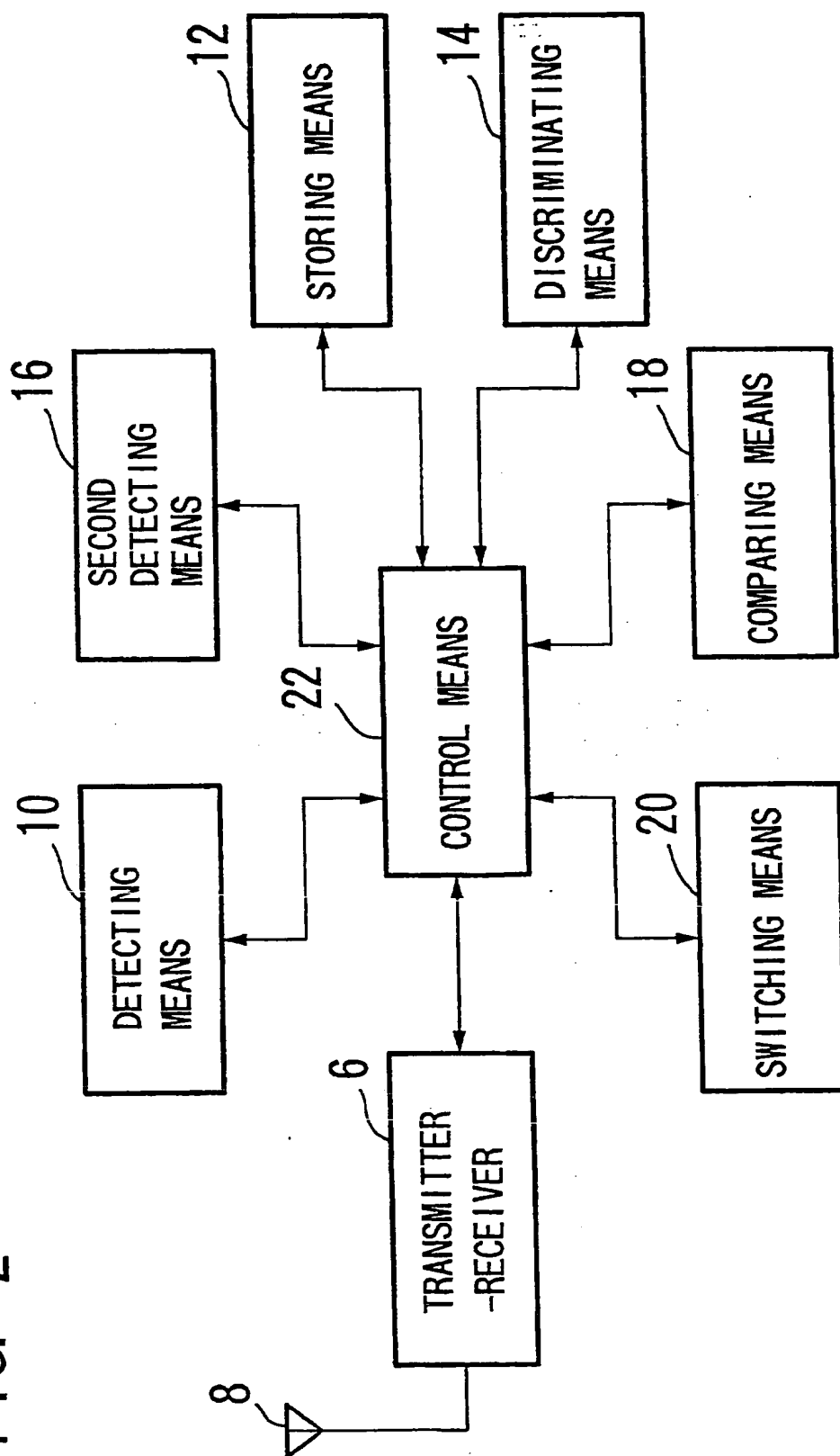
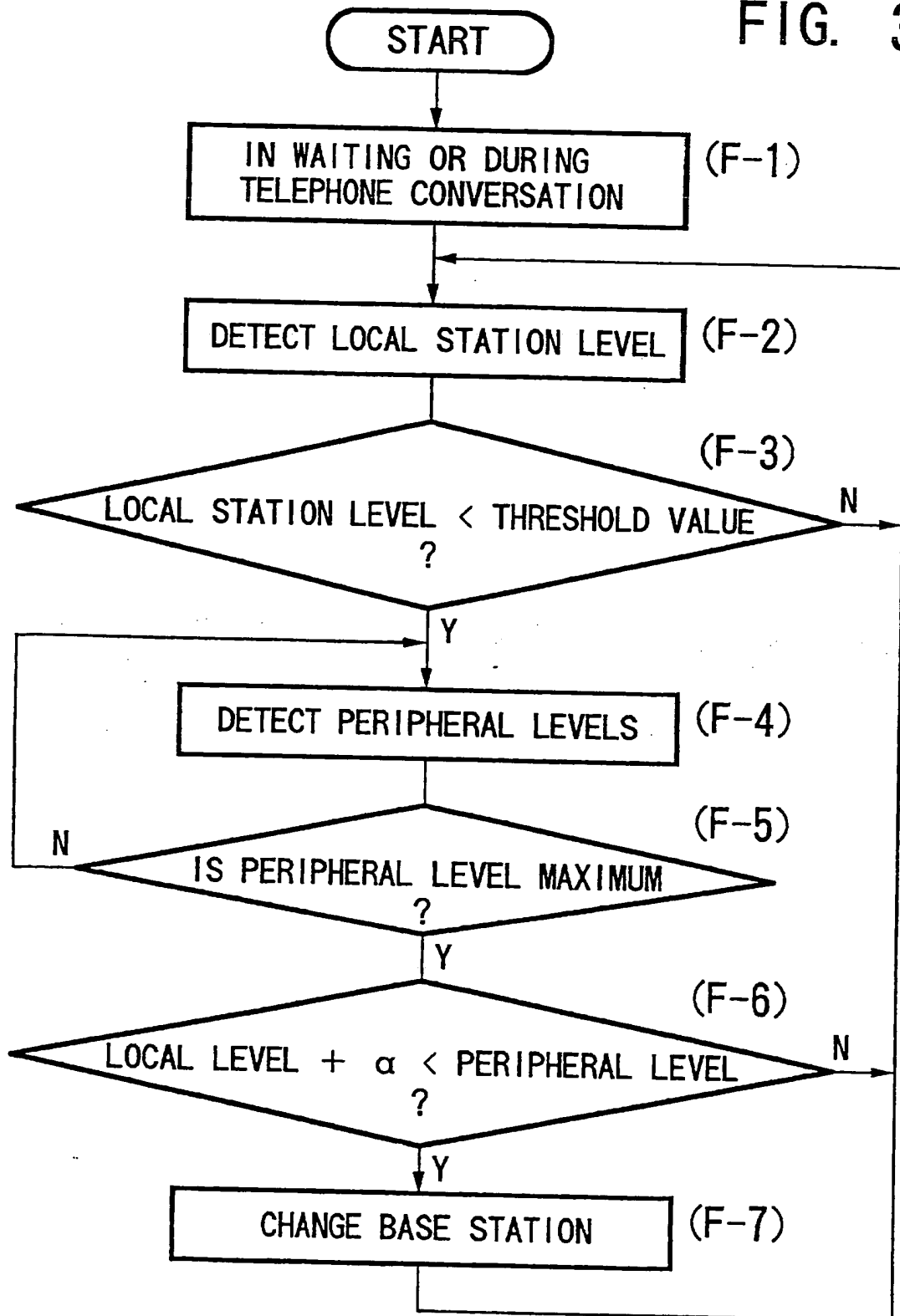


FIG. 3



MOBILE RADIO PHONE UNIT

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a mobile radio phone unit, particularly to improvement in a switching operation when a signal strength from a radio base station of a local station is weakened and connection is changed to another radio base station and, more particularly, to a radio phone unit intending to reduce electric power consumption of a mobile unit and to a method of switching a radio base station.

2. Description of the Related Art

15 In order to always ensure a best telephone conversation during movement of a mobile unit, a radio phone unit selects a radio base station in which the strongest receiving strength can be obtained, connects the radio base station and the mobile unit, and allows them to communicate.

20 Therefore, even during the telephone conversation and in a waiting state in which the conversation is not executed, in addition to the connected radio base station (referred to as a local station), the mobile unit receives signals from radio base stations located around the local station, detects signal strengths of the surrounding radio  
25 base stations, and compares the signal strength of the

connected local station with those of the other radio base stations. When the signal strengths from the other radio base stations are stronger than that of the local station, the mobile unit discriminates that it enters a zone of an adjacent radio base station, changes the connection to the radio base station having the strongest signal strength, and communicates.

In a conventional radio phone unit, however, since the receiving strengths from the surrounding other radio base stations are always detected by the mobile unit as mentioned above, an electric power consumption for the detecting operation is large and such a fact results in a cause of reduction of a continuous using time of a battery.

Hitherto, as mentioned above, the signal strength of the other radio base station is detected irrespective of the signal strength of the local station. Even if the detected signal strength of the radio base station is weakened, a channel is not switched, so that the detecting operation is wasted.

#### SUMMARY OF THE INVENTION

According to the invention, it is an object to provide a mobile radio phone unit in which an operation to change a radio base station is improved, an electric power consumption required for changing the radio

base station is reduced, and a waste of battery is prevented and a radio base station changing method for the radio phone unit.

In a first aspect, the present invention provides a  
5 mobile radio phone unit comprising:

a mobile radio phone unit comprising:

means for comparing the strength of a signal received from a base station to a predetermined level; and

10 means for detecting the strength of signals from base stations in the vicinity of said base station if the strength of the signal received from the base station is equal to or less than said predetermined level.

In a second aspect, the present invention provides a mobile radio phone unit for detecting the strengths of  
15 signals received from a plurality of radio base stations and performing communication via a radio link with one of said radio base stations selected based on the strength of the received signals, said unit comprising:

20 detecting means for detecting the strengths of signals received from said radio base stations;

storing means for storing a threshold value of signal strength; and

25 control means for executing the detection of the strength of signals from radio base stations in the vicinity of said one of the base stations when the strength of the signal from that station is equal to or less than said threshold value.

In a preferred embodiment, the mobile unit comprises detecting means for detecting a signal strength of a radio  
30 base station (hereinbelow, referred to as a local station) to which the unit is connected; storing means for storing a threshold value of the signal strength; second detecting means for detecting signal strengths of the other radio base stations located around the local station; and control  
35 means for executing no detection of receiving strengths of the surrounding radio base stations until a receiving strength of the local station decreases so as to be lower

than the threshold value stored in the storing means, making the second detecting means operate when the strength is equal to the threshold value or less, and detecting the signal strengths of the surrounding radio base stations.

Consequently, when the signal strength of the local station holds enough strength to continue a telephone conversation, the operation for detecting the signal strengths of the other radio base stations located around the local station is not executed, an electric power for detecting the signal strength is not wasted, and a usable time of a battery mounted on the mobile unit can be extended.

When the receiving strength of the local station is lower than the threshold value stored in the storing means, the signal strength of the local radio base station is compared with the strongest signal strength of the other radio base station and, when the strength of the signal of the other radio base station is higher than that of the local station by a predetermined value or more, a channel is changed to the radio base station.

In a third aspect, the present invention provides a method of controlling communication between a mobile radio phone unit and a base station, said method comprising the steps of:

comparing the strength of a signal received from a base station with a predetermined level; and

detecting the strength of signals from other base stations in the vicinity of said base station if the strength of the signal received from the base station is equal to or less than a predetermined value.

In a fourth aspect, the present invention provides a method of controlling communication between a base station and a mobile radio phone unit for detecting the strengths of signals received from a plurality of radio base stations and performing communication via a radio link with one radio base station based on the strength of the received signals, said method comprising the steps of:



detecting the strengths of signals from the radio base stations in the vicinity of said one radio base station when the strength of the signal from that radio base station is equal to or less than a previously stored threshold value;

selecting the radio base station having a maximum signal strength among the detected signals;

comparing said maximum signal strength with the strength of the signal from said one radio base station;

connecting said mobile unit to the selected radio base station if the maximum signal strength is larger than that of said one station by a predetermined value or more.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Preferred features of the present invention will now be described, purely by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a general view showing a radio phone unit;

Fig. 2 is a block diagram showing control means of the radio phone unit; and

Fig. 3 is a flowchart showing operation of the radio phone unit.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of a radio phone unit according to the invention will now be explained hereinbelow with reference to the drawings.

As shown in Fig. 1, the radio phone unit comprises radio base stations 2A, 2B, and 2C provided in zones 3A, 3B, and 3C; and a movable mobile unit 4, and connects the mobile

unit 4 to any one of the radio base stations 2A, 2B, and 2C by radio and allows them to have a telephone conversation.

Fig. 2 shows a block diagram of a control of the mobile unit 4. As shown in Fig. 2, the mobile unit 4 comprises a transmitter-receiver 6; an antenna 8; detecting means 10 for detecting a strength of a signal of the radio base station 2A; storing means 12 for storing a threshold value; discriminating means 14 for discriminating whether the signal strength detected by the detecting means 10 exceeds the threshold value or not; second detecting means 16 for detecting signal strengths of the other radio base stations 2B and 2C which are not connected; comparing means 18 for comparing the signal strength of the local station with those of the other radio base stations 2B and 2C which are not connected; switching means 20 for switching the radio base stations 2A, 2B, and 2C; and control means 22 for controlling the whole.

The detecting means 10 detects the signal strength of the connected radio base station, namely, local station 2 at all times or every predetermined time and transmits the detected signal strength to the control means 22. The threshold value stored in the storing means 12 is a value obtained from the lowest signal strength at which the communication can be certainly executed and, when the signal strength is lowered than the threshold value, it is a value

at which it is desirable that the connection is changed to the surrounding other radio base station 2B or 2C.

The discriminating means 14 compares the threshold value stored in the storing means 12 with the signal strength detected by the detecting means 10, discriminates whether the signal strength of the local station is equal to the threshold value or less or not, and when the signal strength of the local station is lower than the threshold value, notifies the control means 22 of the fact.

The second detecting means 16 detects the signal strengths of the surrounding other radio base stations 2B and 2C except for the local station. It is also sufficient that one detecting means is provided and the signal strength of the surrounding other radio base station is received by switching the radio base stations 2A, 2B, and 2C to be detected.

The comparing means 18 selects the radio base station 2B or 2C having the maximum signal strength among the other radio base stations detected by the second detecting means 16 and compares the signal strength of the radio base station 2B or 2C with that of the local station. When the signal strength of the selected radio base station 2B or 2C is larger than that of the local station by a predetermined value or more, the means notifies the control means 22 of the fact.

When the notification that the radio base station (for example, radio base station 2B) having the signal strength that is larger than that of the local station exists is sent from the comparing means 18 to the control means 22, an instruction to switch is generated from the control means 22, the switching means 20 switches so as to connect the mobile unit 4 to the radio base station (for example, radio base station 2B) having the maximum signal strength detected by the second detecting means 16 in accordance with the instruction.

The operation of the radio phone unit 1 will now be described with reference to Fig. 3.

First, the mobile unit 4 detects the radio base station 2A in the zone 3A where the mobile unit 4 is included and connects to the radio base station 2A (F-1). In the mobile unit 4, even in the waiting state or during the telephone conversation, the detecting means 10 always detects the signal strength of the connected radio base station (namely, local station) 2A (F-2). The discriminating means 14 compares the threshold value with the signal strength (F-3). When the signal strength of the local station is higher than the threshold value, the state is continued even in the waiting state or during the telephone conversation.

On the other hand, when the discriminating means 14 discriminates that the signal strength is lower than the

threshold value (F-3), the second detecting means 16 is made operate, signals of the other radio base stations 2B and 2C located around the mobile unit 4 are detected (F-4), and the values are transmitted to the comparing means 18. The  
5 comparing means 18 selects the radio base station (for example, radio base station 2B) having the maximum signal strength among the detected signals of the radio base stations 2B and 2C (F-5). Further, the maximum signal strength of the radio base station is compared with the  
10 signal strength of the local station 2A (F-6). When the signal strength of the other radio base station 2B is stronger than that of the local station 2A by a predetermined value d or more, a channel of the mobile unit 4 is switched to the radio base station 2B having the maximum signal  
15 strength by the switching means 20 (F-7).

Therefore, according to the radio phone unit 1, since the signal strengths of the surrounding radio base stations 2B and 2C are not detected so long as the receiving strength of the local station 2A is higher than the threshold  
20 value stored in the storing means 12, the electric power consumption of the mobile unit 4 can be reduced and a waste of battery can be prevented. When the mobile unit 4 actually moves or the like and the signal strength of the local station 2A is deteriorated, the connection is changed to the  
25 other radio base station (for instance, radio base station

2B) having the maximum signal strength and the optimum communication can be realized.

As a first effect according to the invention, since the signal strengths of the other radio base stations are not  
5 detected until the receiving strength of the local station is equal to the threshold value or less, the electric power which is consumed in order to detect the signal strengths of the other radio base stations can be reduced, so that the waste of battery can be prevented.

10 As a second effect, when the receiving strength of the local station is lower than the threshold value, the channel is not changed so long as it is higher than the signal strengths of the surrounding radio base stations, so that it is prevented that the channel is switched to the  
15 radio base station having a weak signal strength.

As a third effect, even when the receiving strength of the local station is lower than the threshold value, the channel is not changed so long as the signal strengths of the surrounding radio base stations are not higher than that of  
20 the local station by a predetermined value or more, so that it is prevented that the channel is often switched to the radio base station having substantially the same signal strength.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

Statements in this specification of the "objects of the invention" relate to preferred embodiments of the invention, but not necessarily to all embodiments of the invention falling within the claims.

The description of the invention with reference to the drawings is by way of example only.

The text of the abstract filed herewith is repeated here as part of the specification.

The present invention relates to a radio phone unit in which electric power consumption required to change connection to a radio base station due to a zone change or the like is reduced and a waste of battery of a mobile unit is prevented. A control section compares a signal strength of a local station with a threshold value and, when it is not lower than the threshold value, waits as it is or continues communication. On the other hand, when the signal strength of the local station is lower than the threshold value, the control section detects signal strengths of the other radio base stations and selects the radio base station having the maximum signal strength among them. Further, the control section compares the signal strength of the selected radio base station with that of the local station and, when it exceeds the signal strength of the local station, switches a channel to the radio base station having the maximum signal station. Consequently, when the mobile unit exists in an ordinary zone, no waste detecting operation is executed and the electric power consumption accompanied by the detecting operation can be reduced.

CLAIMS

1. A mobile radio phone unit comprising:  
means for comparing the strength of a signal received  
5 from a base station to a predetermined level; and  
means for detecting the strength of signals from base  
stations in the vicinity of said base station if the  
strength of the signal received from the base station is  
equal to or less than said predetermined level.
- 10 2. A mobile radio phone unit according to claim 1,  
further comprising means for storing said predetermined  
level.
3. A mobile radio phone unit according to claim 1 or  
2, further comprising means for executing the detection of  
15 the strength of signals from the base stations surrounding  
said base station if the strength of the signal received  
from the base station is equal to or less than said  
predetermined level.
4. A mobile radio phone unit for detecting the  
20 strengths of signals received from a plurality of radio  
base stations and performing communication via a radio link  
with one of said radio base stations selected based on the  
strength of the received signals, said unit comprising:  
detecting means for detecting the strengths of signals  
25 received from said radio base stations;  
storing means for storing a threshold value of signal  
strength; and  
control means for executing the detection of the  
strength of signals from radio base stations in the  
30 vicinity of said one of the base stations when the strength  
of the signal from that station is equal to or less than  
said threshold value.
5. A mobile radio phone unit according to claim 4,  
wherein said control means does not execute the detection  
35 of the strengths of signals from the surrounding radio base



stations when the strength of the signal from said one of the base stations is greater than the threshold value.

5        6.    A mobile radio phone unit according to claim 4 or  
base station having the maximum strength signal among the  
detected signal strengths, compares the strength of that  
signal with that of said one of said base stations, and,  
when the strength of the signal from said selected radio  
10    base station is larger than that of said one of the base  
stations by a predetermined value or more, connects said  
mobile unit to the selected radio base station.

15       7.    A mobile radio phone unit according to any of  
claims 4 to 6, wherein after the strengths of the signals  
from the surrounding radio base stations are detected, the  
strength of the signal from said one of the base stations  
is detected again, and if the detected strength of the  
signal from that base station exceeds said threshold value,  
connection between the mobile unit and that base station is  
20    continued.

8.    A method of controlling communication between a  
mobile radio phone unit and a base station, said method  
comprising the steps of:

25       comparing the strength of a signal received from a  
base station with a predetermined level; and

detecting the strength of signals from other base  
stations in the vicinity of said base station if the  
strength of the signal received from the base station is  
equal to or less than a predetermined value.

30       9.    A method of controlling communication between a  
base station and a mobile radio phone unit for detecting  
the strengths of signals received from a plurality of radio  
base stations and performing communication via a radio link  
with one radio base station based on the strength of the

received signals, said method comprising the steps of:

detecting the strengths of signals from the radio base stations in the vicinity of said one radio base station  
5 when the strength of the signal from that radio base station is equal to or less than a previously stored threshold value;

selecting the radio base station having a maximum signal strength among the detected signals;

10 comparing said maximum signal strength with the strength of the signal from said one radio base station;

connecting said mobile unit to the selected radio base station if the maximum signal strength is larger than that of said one station by a predetermined value or more.

15 10. A method according to claim 9, wherein after the strengths of the signals from the surrounding radio base stations are detected, the strength of the signal from said one radio base station is detected again and, if said  
20 detected strength of the signal from that radio base station exceeds said threshold value, connection between the mobile unit and that radio base station is continued.

11. A mobile radio phone unit substantially as herein described with reference to and as shown in figure 1 of the accompanying drawings.

25 12. A method of controlling communication between a mobile radio phone unit and a base station substantially as herein described with reference to the accompanying drawings.



Application No: GB 9901226.2  
Claims searched: 1-12

Examiner: Robert Macdonald  
Date of search: 7 April 1999

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.Q): H4L(LDSHE, LDSHS, LDSHX, LECTP)  
Int Cl (Ed.6): H04Q(7/18, 7/38)  
Other: ONLINE: WPI, EDOC, PAJ

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X,E	GB 2328582 A (NEC) Whole ocument.	1-4 and 8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**THIS PAGE BLANK (USPTO)**